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EVIDENCE OF INSEMINATION OF MULTIPLE FEMALES BY THE MALE BLACK WIDOW SPIDER, *LATRODECTUS MACTANS* (ARANEAE, THERIDIIDAE)

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ABSTRACT

In a series of laboratory matings, adult *Latrodectus mactans* males were allowed to mate with up to three virgin females. The results demonstrate that *L. mactans* males are capable of successfully inseminating at least three females and that the tip of the embolus (apical sclerite) is not required for sperm transfer.

An escape mechanism used by the male involving possible spatial disorientation of the female in her web during courtship and mating is described.

INTRODUCTION

Courtship and mating in *Latrodectus* has been studied by a number of workers (Ross and Smith 1979, Kaston 1970, Abalos and Baez 1963, Bhatnagar and Rempel 1962, Baerg 1959, Smithers 1944, D'Amour et al. 1936, Burt 1935, Herms et al. 1935, Blair 1934). Despite myths to the contrary, it is well documented that the male need not be killed by the female after mating. The incidence of escape by the male has been correlated with the degree of hunger in the female (Ross and Smith 1979, Kaston 1970). In addition, the ability of the male black widow to successfully inseminate a number of females has been discredited (Foelix 1982, Abalos and Baez 1963, Bhatnagar and Rempel 1962). As Foelix (1982) stated of *Latrodectus* "the lengthy emboli often break off during copulation and remain stuck in the epigynum of the female preventing either sex from mating again." Abalos and Baez (1963) noted of *Latrodectus* "the breaking of the apical element (sclerite) of the male palpus is a mutilation that renders the male unable to carry out further matings." They claimed that if the male is not killed by the female after mating, it perishes after a few days. They explained away as mistaken observation reports by Herms et al. (1935) and Montgomery (1903) of males mating more than once. Bhatnagar and Rempel (1962) conceded that in *Latrodectus curacaviensis* (Muller) (= *Latrodectus hesperus* Chamberlin and Ivie, Kaston 1970) the female could perform multiple matings unlike the males. They further noted "males that have copulated can be identified on the basis of a broken embolus, a male individual can copulate only once, for two reasons.

Firstly, an embolus with a broken tip cannot penetrate a bursa, secondly, the whole structure of the palpal organ is such that, after the first copulation, it will not return to its original position and the organ may not be stimulated to enact copulation again."

To test the validity of these statements, a series of matings were staged where males were given the opportunity to copulate with two or three virgin females.

METHODS

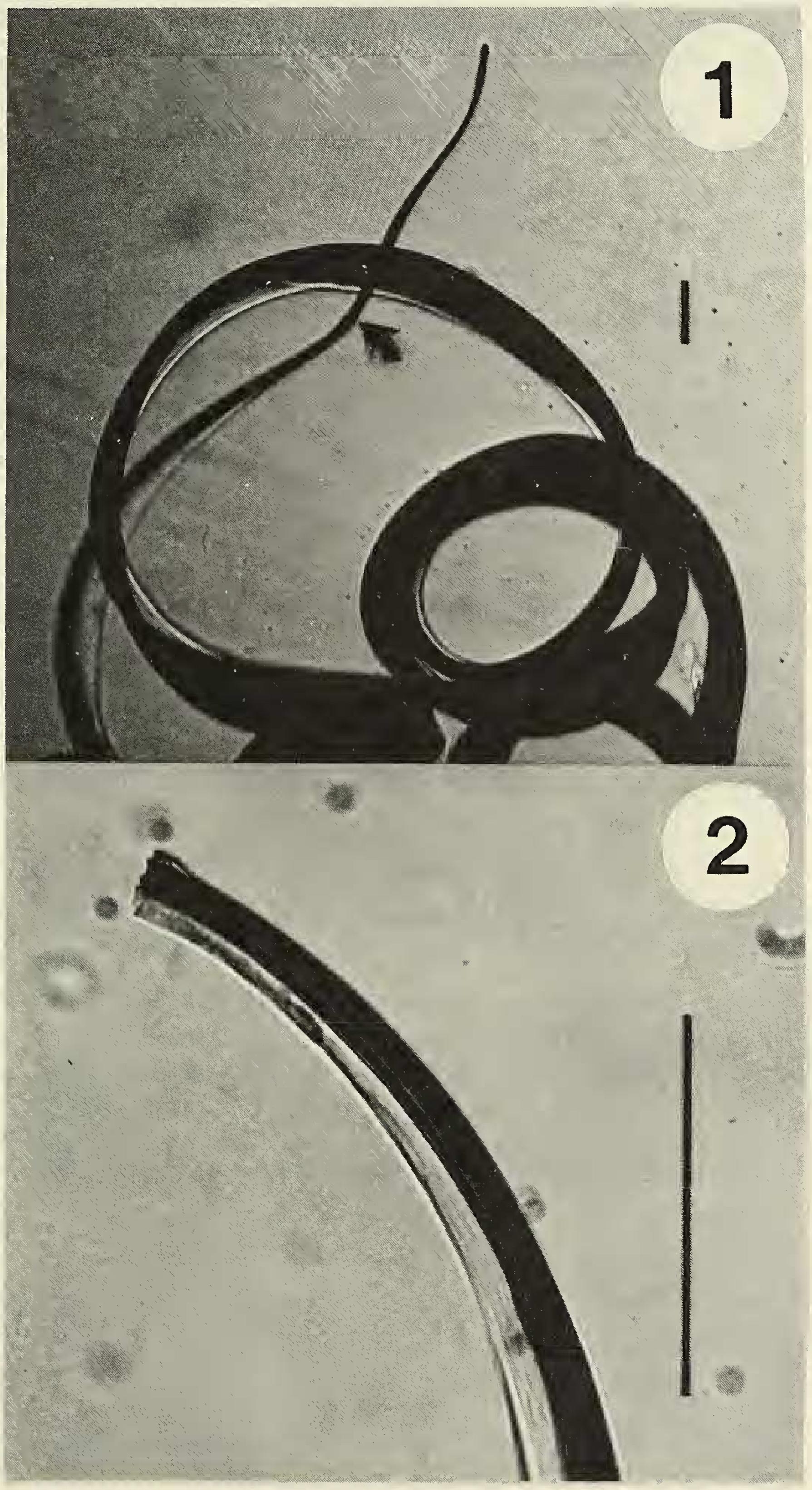
Spiderlings from three eggsacs spun by a laboratory reared *Latrodectus mactans* (Fabricius) female that had been mated with a wild male (College Station, Texas) were used. The spiderlings were reared to adulthood individually from the second instar (third true instar) to ensure virginity. The group consisted of thirty females and eighteen males. Eight males were allowed to mate once, eight twice and two males were allowed to mate three times using the virgin females. Once introduced into the female's snare, the male was permitted to remain until all courtship and mating behavior ceased, usually between three and ten hours. Between matings, the males were placed into fresh containers where (as with every male in which this was done) they built a normal web, and behaved similarly to immature or unmated adult males in captivity. The males were killed and checked for the presence of the apical sclerite following their last mating. All eggsacs spun by the mated females were collected as they were made and attached to the foam top of 100 ml glass vials until emergence of the spiderlings or until the eggsac was found to be infertile. Insemination of a female was considered successful only when living, active spiderlings emerged or were dissected out of an eggsac spun by the female, and not by inspection of the epigynum for traces of semen. As a result, more females were probably inseminated than the data would account for, but this insures that only a parthenogenetic event would provide false positive data. Parthenogenesis is unknown in *Latrodectus,* although Kaston (1968) reports numerous examples of infertile eggsacs being spun by virgin females.

RESULTS

No apical sclerite (the tip of the embolus) remained on either palpus of the first group of males allowed to mate once. Five of the eight females of this first group later spun eggsacs from which active spiderlings emerged. The second group of eight males were allowed to mate with virgin females, then removed after copulation and rested for a few days to two weeks before being allowed to mate with another group of virgin females. One male of this second group retained both apical sclerites, another had the left sclerite still present and the six others were missing both apical sclerites. The male that had retained both sclerites was also the only male unsuccessful in inseminating a female in both attempts based on data from spiderling emergence from ensuing eggsacs. Two of the eight males in the second group were successful in inseminating females in both matings, three males only in the first, and one male only in the second. The third and final group consisted of two males that were allowed to mate with three separate virgin females each. The apical sclerites were missing on both males and all six females involved later spun eggsacs from which active spiderlings emerged.

DISCUSSION

The males allowed to mate once had both of their apical sclerites missing and this loss after the first copulation is probably normal in the majority of males. The male's success in inseminating a second virgin female might have been due to retention of at least one of the apical sclerites which they then used in the



Figs. 1-2.—*Latrodectus mactans,* male genitalia: 1, Left palpus of unmated male, apical sclerite intact; 2, Condition of embolus after removal of apical sclerite, right palpus of mated male. Arrow indicates the point of attachment of the apical sclerite to the balance of the embolus. Scale line = 0.05 mm.

second copulation. However, the two males which inseminated three virgin females each demonstrates that not all *L. mactans* males require the presence of an apical sclerite to successfully transfer sperm. The gross morphology of the apical sclerite appears insufficient to somehow discourage or obstruct a second male from copulating with a previously mated female, and indeed, multiple apical sclerites have been found lodged in the seminal receptacles of *Latrodectus* (Kaston 1970, Abalos and Baez 1963), nor does it serve as a cap or plug as in many species of *Araneus* (Levi 1974). Perhaps the apical sclerite functions in the initial charging of the palpal organs with sperm.

Courtship and mating can be divided into three sequences in *L. mactans*. The first sequence is one of initiation. Upon introduction to the female's web, the male apparently contacts female pheromone that is incorporated in her silk (Ross and Smith 1979), which serves as a set of instructions or prime releasers, triggering courtship behavior. Secondly is the cutting sequence. The period between initiation and the original approach to the female is the first cutting sequence. After initiation, the male starts cutting away and loosely wrapping sections of the female's web. Concentrated sheets and bands (Kaston 1970) as well as balls are the shapes commonly observed formed by the male from the female's snare. The cutting sequence ends when the male slows, then cautiously approaches the female. The mean duration of the first cutting sequence (n = 30) was 58.5 minutes. In all our observations, the male was repulsed on the first approach, after which he resumed a cutting sequence. If rejected a second time, he began a third cutting sequence, and so on. Throughout the cutting periods the male vibrates his abdomen, preparing the female for mating by putting her in a trance (see Kaston 1970). The third sequence is the copulatory one. The female lets the male approach, spin the "bridal veil" and inseminate her, however, copulation can be interrupted by the female at any point, sending the male into another cutting sequence. We suggest that the cutting behavior of the male black widow prior to mating may serve to spatially disorient the female in her own web, especially if the male's silk, as is probable, contains pheromone that placates the female (Ross and Smith 1979). This behavior could effectively "blind" the female since her primary sensory contact with the environment is tactile and through her web. This "blinding" may serve to enhance the male's success in evading an attack by the female. We also propose that the "bridal veil" spun by the male prior to copulation, even though it may detain the female for a second or less, is sufficient to allow the male to escape by immediately dropping out of range, with little or no chance of successful pursuit by the female due to her disorientation in what is now the unfamiliar territory of her cut web. Ross and Smith (1979) working with *L. hesperus* suggested if the male could not successfully mate again, its reproductive success would be best served by providing the female with the energy of its body instead of wandering off to die as was generally believed. Only two of the eighteen males used were consumed by females. Both had inseminated a female in their first mating and both had apparently failed on their second and final mating to inseminate a female. These data, coupled with the surprising longevity and agility of the adult male black widow, lead us to suggest that the failure of an *L. mactans* male to escape the female after (or before) copulation may be due more to the physiological condition of the male at the time of mating than to the relative hunger of the female. We further suggest that a larger study using the easily reared *L. mactans* might reveal more realistic frequencies of many different behavioral events observed in black widow spiders, including the number of copulations a male may participate in over his life span. A variety of useful methods for such a project can be found in Buskirk et al. (1984).

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